Introduction

The rate of hospital closures in the United States has rapidly accelerated in recent years. These closures have been disproportionately in rural areas, where hospitals tend to draw from a smaller patient base with high enrollment in Medicare and/or Medicaid. Because of rural hospitals’ geographic isolation and dependence on reimbursements from public insurance, the Center for Medicare and Medicaid Services designates certain hospitals as Critical Access Hospitals (CAHs). These hospitals are given higher-than-normal cost-based reimbursement rates to help them stay afloat.

Under the Affordable Care Act of 2010, many of Medicare and Medicaid’s reimbursement rates were lowered in order to move away from a fee-for-service model. This put great strain on rural hospitals’ financial sustainability, forcing many to close their doors. Their closure can be particularly devastating to the residents who depend on them, as the next nearest hospital often lies in a different county completely.

From 2010-2017, five rural hospitals in North Carolina closed. This project will examine the impact of the closure of three rural hospitals in North Carolina, two of which were CAHs: Blowing Rock Hospital, Davie Medical Center, and Yadkin Valley Community Hospital. The aim of this project is to determine the extent to which the closure of these three hospitals altered residents’ access to essential medical services using a network analysis in ArcGIS.

Methodology

I obtained data from multiple sources: county shapefiles from the Tufts M Drive, TIGER street centerlines from Census.gov, hospital locations from Data.gov, and parcel data from the Tufts M Drive. I joined these datasets using the TIGER street lines with miles as the measure of interest. Using the Network Analyst tool, I conducted eight different closest facility analyses, one for each county before and after hospital closure and one for each county after the hospital closure. For these analyses, the facilities were the open hospitals in NC at the time of the analysis, and the Incidents were all tax parcels within that county. The result was a Routes layer depicting the shortest route to a hospital for each parcel in the county.

For each county, this routes layer was attribute joined to its corresponding incidents layer, then that layer was spatially joined to the parcel tax parcel layer. This meant that the parcel tax parcel layer had a field for the distance along roads to the nearest hospital.

To identify the specific parcels that had their hospital access changed, the pre-closure parcels were joined to the post-closure parcels for each county. Then a new field called “Distance_Difference” was created, and calculated as the post-closure distance minus the pre-closure distance.

Results

Across the four study counties, 31.8% of all tax parcels experienced a change in their minimum travel distance. Due to the fact that two hospitals closed in the Yadkin/Davie region, changes in travel distance were more common and of a greater magnitude than those in the Watauga/Caldwell region. Watauga and Caldwell Counties also had two other hospitals within their borders, which insulated the majority of both counties from having their nearest hospital change. In Yadkin and Davie Counties, the effect of the hospital closures was pronounced. Over 83% of all parcels had some change to their travel distance, with an average change for those parcels of 4.85 miles in Yadkin County and 4.64 miles in Davie County. The parcels closest to the nearest hospital sites in the centers of the counties suffered the greatest changes, with some parcels having over 10.00 miles increase in travel distance.

Discussion & Conclusion

As we might expect, the closure of these rural hospitals had a considerable impact on residents’ access to the essential medical services that hospitals provide, especially acute care. Residents in rural settings are typically older and in worse health than urban residents.

In Yadkin and Davie Counties, the damage was massive, nearly doubling the average travel distance in both counties. Nearly the entire area of both counties was impacted, with only the northwest corner of Yadkin County and the eastern portion of the region nearest to Winston-Salem avoiding direct impact. Hospitals that are a county’s only provider are especially important to seniors. They are often able to drive, but reluctant to drive on major highways. This means they either forgo care or are forced to take winding country roads with lower speeds and greater distances.

As such, the minimum travel distance calculated in this project may not always reflect the actual distance necessary for many residents. In Yadkin and Caldwell Counties, the impact was less localized but hit some vulnerable areas. For example, the area lying to the southwest of the former Blowing Rock Hospital includes popular recreation spots such as Grandfather Mountain State Park, and the popular ski resort Beech Mountain also lies to the west. The increase in travel distance for those areas, though less substantial than the increase in Yadkin and Davie Counties, is still very dangerous. People critically injured while skiing or rock climbing, time is of the essence. These few extra miles’ journey to Watauga Medical Center could prove fatal.

In beginning this project, I was not able to find tax parcel data that included residential/commercial classifications, so all types were included. This made it difficult to estimate population for the areas impacted and the number of people directly affected. As noted previously, the calculated distances may not reflect the actual required travel distance, nor the time that distance takes to traverse.

While hospital closures may simply be a reflection of a lack of market demand, the impact on the community is real. The large employer in a community, a hospital closure can create a spike in unemployment. The hugely increased distance to the nearest emergency services provider can be very dangerous, with increases in mortality rates for patients with sepsis and acute heart attacks. As such, the majorly increased distances I found in Yadkin and Davie Counties should be concerning for local residents, elected officials, and public health practitioners. Park officials and paramedics in Watauga and Caldwell Counties should also be wary of the increased travel distances from remote areas. Neighboring hospitals should prepare for greater patient loads as people come from greater distances.

Future research should determine the best way to optimize care in communities that have a hospital in danger of closing. Instead of closing, converting the facility to only emergency or urgent care services can reduce costs to maintain access to care for the community and prevent the local economic depression associated with closure. This project should act as a warning to officials in rural communities of the impact of hospital closures. My analysis can help inform efforts to provide relief to those most directly affected and predict the impact of future closures.